

# QUALITY AND QUALITY STANDARDS IN CONSTRUCTION: A SYSTEMATIC REVIEW

N. Azmy, L.W. Wei

## Abstract

One of the customers' satisfactory elements identified in construction is quality, since the construction industry shifted from production-orientated management to customer-orientated management. However, several issues are identified as a hindrance to achieve overall quality and can be caused by low-quality construction materials and non-compliance to the standards. Therefore, before any further strategies to improve the quality of construction are determined, it is crucial to establish the fundamental knowledge on quality and its relevant applicable aspects in the construction industry. Hence, this paper seeks the definition of quality and quality standards by using the systematic review based on six-level of procedures. Based on the sources gathered, quality can be defined as the foreseeable degree of standardisation and reliability with quality standard suitable to the client's preference and approval, whereas quality standards is defined as to offer a reference in ensuring all construction activities comply to the adequate specifications set by the authorised bodies. The definitions found provide practical implications for future work related to quality and project specification.

**Keywords** Quality Standards, Quality in Construction, Quality Implementation, Systematic Review

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## **Introduction**

As Malaysia enters the Industrial Revolution 4.0 and is moving its way forward, there is a major complex transition that occurs from production-oriented management to consumer-oriented management, which is prioritising customer satisfaction or stakeholder satisfaction. Customers' satisfaction is also known as clients' satisfaction or stakeholders' satisfaction, which is one of the key satisfactory elements in construction quality. Based on the statistical review on client satisfaction, Meenakshi (2016) uncovered that quality has emerged as the most determinant of flat buyers' complacency. Quality assurance and quality of assignment materials strongly influence overall customer satisfaction (Kärnä, Junnonen & Kankainen, 2004). Under these circumstances, quality is one of the critical factors to increase their competitiveness (Song, Lee & Park, 2017). Hence, as the construction industry undergoes drastic changes and diversifies in construction methodology, management and technologies, there is a need to upgrade in various areas to achieve quality products.

Nevertheless, many construction companies or projects have incorporated quality management that conforms to quality standards to put themselves in the market race. Yet, accident rates and poor-quality buildings still persistently occur till the rise of a quantum era. Social Security Organisation (SOCSO) stipulates a total of 7,338 cases occurred in 2016 throughout the construction industry as compared to 4,330 cases in 2011, which resulted in a 69.47% increase (Lam Thye, 2018). Additionally, the National Audit Report states that there are 235 sick projects detected in 2011 and 191 projects in 2013 (Jatarona et al., 2017). According to Chai et al. (2015), when there are delays in the projects, they are named as a sick project because these projects will eventually be abandoned with extensive critical delays. The factors contributing to the problems that persistently occur in Malaysia, such as project delays, poor quality, defects, rework and accidents, have similar causes. Building defects and failures are due to low-quality construction materials and non-compliance to specification (Ahzahar et al., 2011). This is also supported by Hong (2016) with homogenous research, which deduced that the

main causes of building defects are poor workmanship, improper tasks performed, non-compliance to material specification and poor supervision. Furthermore, both researchers (Hisham & Yahya, 2016) and (Sambasivan & Soon, 2007) yielded similar findings on the causes of project delays due to poor site management. Notwithstanding, the causes of the problem that persistently occurs in Malaysia lie upon the contractors' responsibility. These problems should be rapidly decreasing due to emerging of technological initiatives to counter the problem. Hence, the bottom line of these issues is how the current contractors understand quality and implement quality standards in Malaysia's construction projects.

Before extensive research can be conducted on the said topic, it is crucial to ensure that the fundamental knowledge on quality in construction is well established. Furthermore, this is necessary to further understand the basic theory on quality and the standards referred to by the practitioners in the industry. Therefore, this paper will explore and examine basic knowledge on quality and its relevant applicable aspects in the construction industry. Hence, this paper provides extensive information on the underlying foundation of quality in construction by performing a literature study.

## **Methodology**

This paper adopts the partial SR method to provide a holistic review that could facilitate this search on the basic information on quality in construction. It adopts the methodological guidelines inaugurated by Templier and Paré (2015), which consists of six steps of conducting literature reviews. The procedures are depicted in Figure 1 below.



**Figure 1:** Procedures in conducting a literature review (Templier & Paré, 2015)

### ***Formulation of the Problem***

Most construction projects have their specifications and the project team must adhere to them throughout the entire construction process. However, not much can be said on whether there are any standards being stated in the contract specifications and how it is being implemented on a construction project. Therefore, before any further research can be made regarding the quality level of the project based on its specifications, it is necessary to look through what other research has reported and identify the gap that exists. Additionally, it is crucial for any study to establish an underlying foundation on the basic knowledge regarding quality in construction, and the elements related to contract and project specification to attain the quality level intended for the project. As for this paper, the review intends to answer the following research objective: define quality and its related elements in construction projects.

### ***Searching the Literature***

The literature review collection begins with searching through books, manuals, published journal articles and conference proceedings through online resources (e.g. Research Gate, Science Direct, IEEE Xplore and Google Scholar). The major expressions for this literature search are “implementation of quality in construction projects” and “quality in construction projects”, to uncover relevant sources as a search strategy. From the major keywords, selected keywords that have co-occurrence with the major expressing keywords are utilised to find any

connection with the research topic. For instance, the keywords “importance of quality in construction” and “factor affecting quality in construction projects” are used to disclose the topic further. According to Table 1, a total of 291 literature from various sources are found based on the related keywords identified.

### ***Screening for Inclusion***

From the literature search process, the 291 literature are then sorted, reviewed and examined in terms of the following elements, (a) research elements related to quality and project specifications, (b) country publication, (c) title, and (d) author(s). Next, a specific collection of requirements is listed to be applied when scrutinising the sources gathered and has to be satisfied to be chosen for further process. The requirements are; (a) focusing on the construction industry, (b) ensuring the implementation of project specifications are focusing on the construction phase, (c) discussing the definition related to the research titles, (d) discussing the process, challenges and influence on *the* implementation of quality standards, (e) sources are written in English, and (f) published sources are dated not more than 10 years ago except for well known theories.

**Table 1:** Number of sources through various database-based platforms on the query of “quality in construction” and “implementation of quality in construction”

Type of sources	Total from various databases
Journal Articles	218
Conference Proceedings	23
Books	30
Manuals	20
<b>TOTAL</b>	<b>291</b>

### ***Accessing Quality***

As the literature review process began with a wider framework stating to define, review and examine the published sources to figure out the context and trends, as stated in the title of this research; namely “implementation of project specification”, the overall quality of the sources needs to be assessed as well. Shortlisted sources from the literature search process are accessed through its results and how the data are analysed, as well as the interpretation of the findings. These sources are further assessed against recognised methodological standards that have been established.

### ***Extracting Data***

Once a thorough search is performed, screening for inclusion is applied and the quality of the sources is accessed. A matrix table is developed to substantiate the important elements of a research. This is essential as it is the process of extracting data from the sources identified and shortlisted in the earlier process. Table 2 depicts the first ten articles searched by the major keywords “quality in construction projects” and “implementation of quality in construction projects”.

**Table 2:** Summary of the first ten articles using major keywords “quality in construction projects” and “implementation of quality in construction projects”

Title	Document Type	Objectives	Methodology	Main Findings	Limitations of the study
Defining Quality in Construction Industry (13 cited)	Journal Article	Identify the definition of quality in the construction industry.	Mixed-Method using open-ended questionnaire and survey towards a local profession in construction.	Customer satisfaction is an outcome measure of quality, but the best quantifiable customer satisfaction is more repeated customers, reduced work and improved safety as quality measures.	Quality in construction is difficult to be quantified and measured. This paper explores the definition of quality in construction.
Case Study on Quality Management System (QA/QC) in Construction Projects (unknown)	Case Study	Determine the importance of quality assurance and quality control implementation, and factors affecting QA and QC management.	Quantitative approach using a questionnaire survey and analysis using relative importance index. Literature review as secondary data.	Importance: - Repeated customer - Increased product value - give benefits to the company in any condition Consequences: -cost overruns -time overruns -litigation -arbitration - disputes	The focus of the study is based on the importance and consequences of management without QA/QC.

Title	Document Type	Objectives	Methodology	Main Findings	Limitations of the study
Study of Quality Management in Construction Projects (33 cited)	Research Article	Explores preliminarily on the implementation of quality management, commitment of the managerial team in quality management and issues related to quality management implementation.	Semi-structure interview.	Total Quality Management (TQM) is not practised regularly, whereas ISO registration is conducted for marketing purposes. TQM's purpose is to fulfil contractual obligations. Besides, the leadership and participation of top management are not fully participating.	No clear view on the overall practice of quality management, as the sample size is small and participants are not transparent enough.
Quality Management at Construction Projects (5 cited)	Research Article	Identify the important element in each phase of QMS.	Quantitative approach using a questionnaire survey.	Satisfaction of all stakeholders in the industry. Better understanding of quality control procedures. Satisfaction of Client. Suitable quality control method for the project. Development of the quality of strength in construction. Total Quality Management at construction projects.	Assessment on real-time management in the industry is needed.



Title	Document Type	Objectives	Methodology	Main Findings	Limitations of the study
Quality Management in Design and Construction Phase: A Case Study (4 cited)	Research Article	Identify quality management in the design and execution phase of construction projects in Pakistan.	Quantitative approach using a questionnaire survey.	The conclusion is 17 out of 33 in Pakistan do not have any implementation of QMS. Quality of design fails if it is not managed accordingly regardless of good designs.	Assessment based on opinion instead of looking at the document execution.
ISO 9001 Quality Standard in Construction (65 cited)	Research Article	Identify the level of implementation on ISO9001: Quality Standard in Construction.	Quantitative approach using a questionnaire survey.	The highest compiled documents are inspection and test status, control of non-conformance products, handling documentation, method of implementation, and corrective action. Setting up priorities for improvement is another area that contractors are not performing.	The assessment is based on ISO9001 Quality Standard, thus not focusing on the project specification.
Importance of Quality for Construction Project Success	Conference Proceedings	Seeks how quality plays an important role in the success of construction project.	Review	Developed a framework of quality for successful of construction project, where quality drawing, constructability of design,	Further elaboration is required to have a practical practice based on the

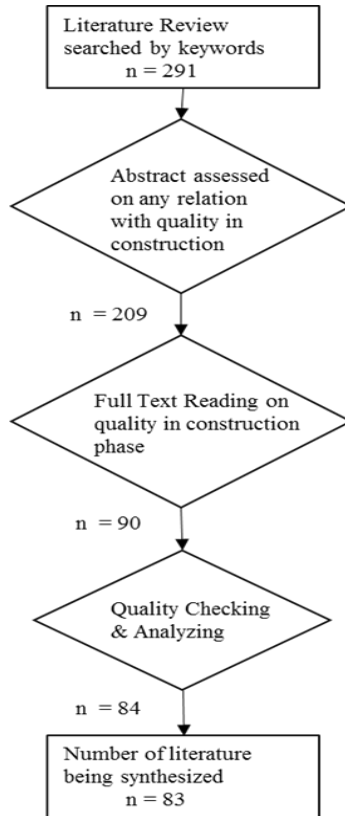
Title	Document Type	Objectives	Methodology	Main Findings	Limitations of the study
(19 cited)				management commitment, training and awareness, and team working are factors enhancing construction project quality.	framework of quality construction project success.
Conceptualisation of Quality Issues in Malaysian Construction Environment  (18 cited)	Conference Proceedings and Research Article	Investigate the quality issue in Malaysia construction environment.	Review with additional quantitative approach on studying the quality issue in Malaysia.	The investigation of quality issues in construction are further examined in aspects such as communication, the nature of construction, management commitment, quality culture, material, relationship with vendors and competitive bidding.	Undefined on the methodology on conducting the studies.
Barriers and benefits of quality management in the construction industry: An empirical study  (140 cited)	Research Article	Defining quality in construction, problem, benefits and barriers of implementation.	Mixed method approach using open-ended interviews and questionnaires. Each questionnaire item is supported with interviews.	The empirical study covers the definition, problems, benefits, barriers and recommendation of improvement implementation.	Low response rate in a questionnaire.

Title	Document Type	Objectives	Methodology	Main Findings	Limitations of the study
Implementation of ISO Quality Management System in Construction Companies of Malaysia (10 cited)	Research Article	Identify the benefits and problems faced by construction companies ISO9001.	Case study accompanied by interviews.	Developed a framework on strategies based on the case studies revealing the problem faced during implementation.	Strategies are based on the case studies.

### *Analysing and Synthesising Data*

This is the final process in the literature review, where all the information extracted are collated, summarised, aggregated, organised and compared from the previous studies.

Once the unrelated content was eliminated through the first filtering, 209 remained for processing. Then, these 209 literature are further filtered through full-text reading that could help fulfil this paper, which dispose 43% of the first filtering literature. Lastly, a total of 83 are taken for synthesising after supplementary quality checking and analysing (Figure 2).



**Figure 2:** Flow diagram of the Literature Review Process

## Result and Findings

Based on the 83 literatures that have been synthesised, only three literatures are found to directly state the definition of quality and another five literature provide the meaning of quality standards in construction. Tables 3 and 4 indicate the authors and the definitions extracted from the literature.

## Conclusions

In the effort of gathering and studying through partial SR on existing studies on this topic to identify the basic knowledge and underlying foundation of quality in construction, the findings show a clear definition of the subject. Sources that are carefully identified and scrutinised throughout the literature review process provide the relevant information needed to establish the basic definition of quality and quality standards. The definitions found certainly provide practical implications for future work. For example, these definitions will be utilised to develop the conceptual framework in order to move forward with the relevant study on achieving quality standards based on project specification and its implementation. The systematic review search performed earlier in this study can be further exploited to derive more basic terminologies related to project specifications and the implementation of project specifications.

**Table 3:** List of authors and their definition of quality

Authors	Definition of Quality
Joseph.M Juran, 2010	Quality is defined as those features of products that match the customer preference and thereby provide customer satisfaction
Edwards Deming, 2012	Good quality as the predictable degree of uniformity and dependability with quality standard suited to the customers

Authors	Definition of Quality
Crosby, 1979	<ol style="list-style-type: none"> <li>1. Quality is conformance to requirements.</li> <li>2. A management system is prevention</li> <li>3. The performance standard is zero defects</li> <li>4. A measurement system is the cost of non-conformance</li> </ol>

**Table 4:** List of authors and their definition of quality standards

Authors	Definition of quality/ Explanation
Pyzdek & Keller, 1999	Standards are documents used to define acceptable conditions or behaviours, and to provide a baseline for assuring that conditions or behaviours meet the acceptable criteria
Kubba, 2010	Specifications are prescription of quality standards of construction expected on the project
Lee et al., 2014	Quality standards are known as established requirements
Furst, 2015	Project specification spells out the quality standards for the projects, and by reference become a part of the contract between the project owner and the contractor
Rumane, 2018	Standard in construction as the construction projects' activities or products meets or comply with the acceptable specifications set by the authorised bodies.

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